

[illegible]

1. Scope:

This specification describes the procedure for removing excessive twist in shelled cold mass units via "flame straightening." The method involves applying a series of angled weld beads to the sides of the shell so that the resulting weld shrinkage offsets the existing twist condition by literally "counter-twisting" the assembly. The procedure is carried out in a very careful and controlled manner whereby the effects of the welding are continuously monitored on the electronic inclinometer LED read-out while the work is in progress.

2. Applicable Documents:

The following documents, of the issue in effect at the time of release for manufacture, form a part of this procedure to the extent specified herein:

RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
RHIC-MAG-Q-1000	Procedure for Control of Measurement Test Equipment
RHIC-MAG-R-7334	RHIC 13cm Quadrupole Yoke Containment Assembly
RHIC-MAG-R-8793	RHIC 13cm Combined Element Straightness, Twist and Survey Measurements

BNL Drawings:

12020017	13cm Q1 Yoke Containment Assembly
12020488	13cm Q3 Yoke Containment Assembly
12020505	13cm Q2 Yoke Containment Assembly
12040286-01 thru 04	13cm Corrector Shell Welding Assembly

3. Requirements:

This twist removal operation shall be carried out in accordance with this specification and the associated engineering drawings.

3.1 Material/Equipment

25-1603.01-4	13cm Twist Bridge with Inclinometer
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3.2 Safety Precautions

- 3.2.1 No welding shall take place unless all welding screens are in place around the welding station, and all personnel not directly involved with the welding process are outside the screens. Any personnel inside the screens shall wear protective gear to prevent eye injury, and shall be clothed to prevent burns caused by intense ultra-violet light.
- 3.2.2 All lifting and handling operations requiring overhead crane operations shall be performed by holders of valid Safety Awareness Certificates. They shall also be trained and certified in the use of the appropriate lifting device by the Cognizant Engineer or Technical Supervisor. Personnel must wear protective head gear and safety shoes during crane operations.

3.3 Procedure

- 3.3.1 Obtain cold mass twist results which were acquired immediately after shell seam welding. The cognizant engineer must have issued instructions that the data indicates an out-of-tolerance twist condition that must be corrected by flame straightening. Append a copy of these "pre-untwisted" measurements to the traveler.
- 3.3.2 Switch on the twist bridge power supply and allow it to warm up for at least one hour in order for it to fully stabilize.
- 3.3.3 Set the cold mass onto two level pairs of McGill precision steel rollers spaced at approximately 1/4 and 3/4 overall cold mass length.
- 3.3.4 Level the magnet on the rollers so that the twist bridge reads zero at axial location 1 (first pair of upper shell holes nearest to magnet lead end). Lock the magnet at this location so that shell hole location 1 continues to remain level and does not rotate during the untwisting process.
- 3.3.5 Using a heavy black magic marker, scribe a straight line 10 ± 2 in. long on the surface of the shell. Center the line between shell hole locations and about the horizontal midplane, and angle it approximately 30 deg in the chosen area to be untwisted. Do the same except in the reverse orientation on the exact opposite side of the cold mass in order to maintain weld symmetry side-to-side and to preserve axial straightness. Refer to Figure 1 which illustrates this concept.

3.3.6 Weld beads shall be applied over the magic marker lines in order to undo the twist. The length and number of weld beads to be applied shall depend on their demonstrated effectiveness, (ie., the degree to which they mitigate axial twist in a particular case). The twist condition at each region between shell holes, (ie., between holes 1 and 2, 2-3, 3-4, etc. where hole location 1 is closest to the lead end) shall be corrected separately and individually. Only a single welder is necessary but weld length, size and filler wire input must be identical on opposite sides or the magnet will bend. Use ER385L filler wire as necessary.

Note: It is not essential that the overall twist be brought down to zero. It is only essential that it be brought to within the prescribed tolerance.

3.3.7 Observe the twist bridge display while welding is in progress so that it is continuously clear that the desired results are being achieved and that no more weld is being laid than is absolutely necessary. Successive welds should be adjacent to but not overlapping previous welds. Also, once a pair of weld beads is laid, wait at least 10 minutes for the welds to cool and the shrinkage to stabilize.

Note: Be mindful that the total result shall always be from matched pairs of welds; it is not permissible to add an uneven number of welds or unequal lengths of welds from side-to-side. Weld lengths should be shortened if necessary to ensure that a matching weld of the same length may be placed on the opposite side of the cold mass.

3.3.8 Generate a new final set of twist data demonstrating that the overall twist is in tolerance. Record this data on Table 1 and append it to the traveler.

3.3.9 Sketch out a diagram which illustrates locations, lengths, and quantity of corrective welds required to untwist the cold mass. Append this diagram to the traveler.

3.3.10 If straightness measurements have been taken prior to untwisting, then they shall be repeated at this time. These measurements shall be performed in accordance with RHIC-MAG-R-8793.

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4. Quality Assurance Provisions:

- 4.1 The Quality Assurance provisions of this procedure require that all assembly and test operations be performed in accordance with the procedural instructions contained herein.
- 4.2 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.
- 4.3 All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

5. Preparation for Delivery:

N/A

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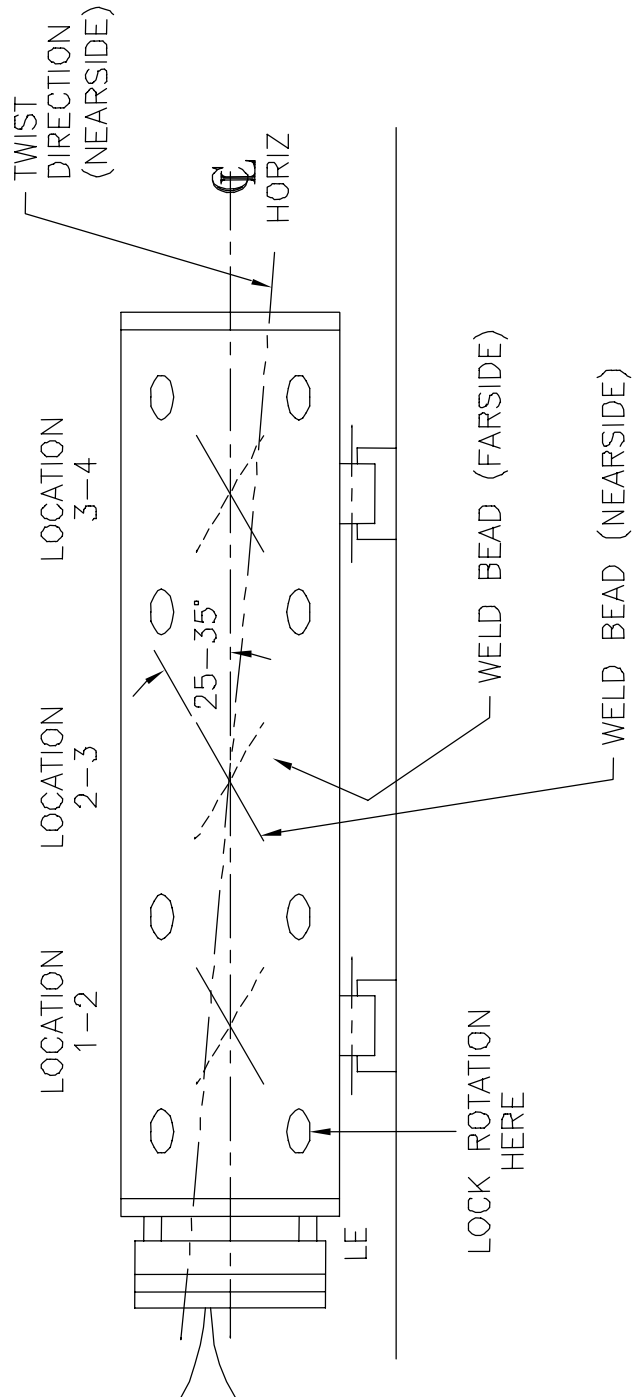
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TABLE 1

CQ13 Twist Measurements

Magnet _____ Tech. Signature _____ Date: _____

Shell Hole Axial Location	Distance From LE End Plate (in)	Inclination (Mrad)
1		
2		
3		
4		
5		
6		
7		
8		
9		



NOTE: WELD BEADS SHOWN SHALL PRODUCE COUNTER-CLOCKWISE UNTWISTING AS VIEWED FROM LEAD END. WELD BEAD ANGLE MUST BE REVERSED TO PRODUCE CLOCKWISE UNTWISTING.

CQ13 TWIST REMOVAL

FIGURE 1

AL/JOHNC
plot: 1/1